Section 9 - West Colorado River Basin
Water Planning and Development

Section 9
West Colorado River Basin - Utah State Water Plan

Water Planning and Development

9.1 Introduction

This section describes the major existing water development projects and proposed water planning and development activities in the West Colorado River Basin. The existing water supplies are vital to the existence of the local communities while also providing aesthetic and environmental values.

This plan provides local decision-makers with data to solve existing problems and to plan for future implementation of the most viable alternatives.

9.2 Background

Development in the late 1800s was by groups of individuals with a common cause. It was a matter of surviving in a newly settled area.

Wide Hollow Replacement Reservoir site

The coordination and cooperation of all water-related government agencies, local organizations and individual water users will be required as the basin tries to meet its future water needs.

As demands for municipal and industrial (M&I) water increase, supplies will come primarily from additional surface water treatment, which will develop existing water rights and conservation. Additional water supplies could come from cloud seeding activities and possibly tapping the basin-wide Navajo Sandstone aquifer. Of the total water diverted for all uses, (not including wetlands and open water evaporation) nearly 85 percent is for agricultural and livestock purposes. The current diversion for municipal and industrial (M&I) water is about 15 percent of the total, which will probably increase slightly in the future.

9.2.1 Past Water Planning and Development

At the time of the earliest settlements, individuals and groups generally did their own planning and development of the water needed for various uses. Later, technical and financial assistance became available from state and federal agencies.

Many projects and facilities have been constructed over the years to develop the needed water resources. Eighteen storage reservoirs with capacities over 1,000 acre-feet have been constructed in the basin, primarily for irrigation purposes. Of these, Scofield, Joes Valley and

Huntington North were funded and constructed by the federal government (Bureau of Reclamation and Department of Agriculture). See Section 6, Table 6-1, Existing Lakes and Reservoirs. Figure 6-1 shows their locations. Many smaller reservoirs for single and multiple purposes have been built for irrigation, flood control, stock watering and fishing. The total surface water storage capacity in the basin is over 475,000 acre-feet. In addition, Lake Powell has 26,373,000 acre-feet of capacity, but no water is delivered from Lake Powell to water users in the basin.

Other projects have been carried out through the Agricultural Conservation Program and the Agricultural Resource Development Loan Program. These include sprinklers, pipelines and other agricultural-related projects.

The Natural Resources Conservation Service has spent considerable effort planning and developing irrigation projects. These projects reduce erosion, provide sediment control, flood water and irrigation water storage, and provide conveyance systems and on-farm improvements.

Much of the water planning and development carried out by the state has been through the Division of Water Resources. The Utah Board of Water Resources has provided technical assistance and much needed funding for 97 projects totaling nearly $20.5 million.

In the last five years, seven Board of Water Resources projects have been constructed in the West Colorado River Basin. These include culinary improvements in Carbon and Wayne counties, irrigation projects in Carbon and Wayne counties, and a dam repair project in Emery County (see Table 9-1).

9.2.2 Current Water Planning and Development

The Price-San Rafael Rivers Unit of the Colorado River Salinity Control Program is currently being implemented to help water users in Carbon and Emery counties improve farm irrigation efficiencies and to reduce salt loading in the Colorado River system by 161,000 tons. Salinity contributed to the Colorado River from the Price and San Rafael river drainages comes from dissolved salts in return flows from irrigation and surface runoff. An estimated 430,000 tons of salt per year reach the Colorado River from these two drainages. Of this amount, approximately 60 percent is attributed to agriculture.

Five alternative plans for reducing Colorado River salt-loading have been evaluated by the Bureau of Reclamation (BR), the Natural Resources Conservation Service (NRCS) and the Department of Agriculture (USDA). These alternatives include: 1) Improving irrigation systems, 2) using drain water for power plant cooling, 3) collecting saline water and disposing of it through deep well injection, evaporation ponds, or a desalting plant, 4) using saline water for energy development (coal washing, tar sands, or coal slurry pipeline), and 5) retiring land from irrigation. Of these, the irrigation systems improvement alternative passed the four tests of viability (completeness, effectiveness, efficiency and acceptability).

The current plan combines the BR and USDA programs of irrigation improvements, primarily sprinkler irrigation systems. The plan would also eliminate winter water from the canal system by installing a rural stock water distribution system. The preferred plan will include installing 97 miles of pipe for irrigation water, 26,000 acres of improved irrigation systems, 10,040 acres of improved irrigation surface systems, 36,050 acres of improved irrigation water management, lining 83 stock ponds, adding 213 connections to culinary systems to provide winter livestock water, and installing 10.6 miles of pipe to improve the livestock water facilities. Local landowners would install on-farm systems with technical assistance from USDA. Figure 9-1 shows a general map of the project area. A joint BR/USDA planning report and final environmental impact statement was completed in December 1993. Construction of portions of this unit started in 1998 under the USBR basin-wide salinity program and the USDA EQUIP program. The Division of Water Resources has cost-shared on three local salinity projects, Wellington City, Ferron Canal and Reservoir Company, and Price-Wellington Control Board.

Table 9-1
Board of Water Resources Development Projects

Sponsor	Type	Year
	Carbon County	
Book Cliff Water Company	Culinary System	1987
Carbonville Water Co.	Culinary Pipe	1972
East Carbon City	Culinary Treatment Plant	1983
East Carbon City	Culinary Tank	1995
East Price Water Co.	Culinary Pipe	1958
Emery Star Water Co.	Culinary System	1983
Haycock Lane Water Corp.	Culinary Pipe	1985
Helper City	Culinary Tank	1980
Kenilworth Utilities Co., Inc.	Culinary System	1983
Miller Creek Water SSD	Culinary System	1983
Price City	Culinary Tank	1981
Price River WID	Culinary System	1976
Price River WID	Culinary Tank	1982
Price River WID	Culinary Tank	1982
Price River WID	Diversion Dam	1986
Price River WID	Culinary System	1989
Price River WID	Culinary Treatment Plant	1996
South Price Water Co.	Culinary Pipe	1973
Stowell Mutual Water & Canal Co.	Low Head Pipe	1993
Wellington Canal Co.	Miscellaneous	1950
Wellington Canal Co.	Miscellaneous	1952
Wellington Canal Co.	Low Head Pipe	1977
West Side Water Co.	Culinary Tank	1973
Carbon County Total	23	
	Emery County	
Castle Dale City	Culinary Pipe	1976
Castle Valley SSD	Dual Water System	1982
Castle Valley SSD	Culinary Pipe	1984
Castle Valley SSD	Culinary Pipe	1984
Clawson Area S&WID	Culinary Tank	1983
Clawson Waterworks Co.	Culinary Pipe	1970
Cottonwood Cr. Consol. Irr. Co.	Pressurized Pipe	1977
Ferron Canal & Reservoir Co.	Dam and Reservoir	1968
Ferron Canal & Reservoir Co.	Dam Repair	1992
Ferron City	Culinary Pipe	1976
Huntington City	Culinary Tank	1976
Huntington-Cleveland Irr. Co.	Dam Enlargement	1953
Huntington-Cleveland Irr. Co.	Dam Repair	1976
Independent Canal & Res. Co.	Dam and Reservoir	1952
Orangeville City	Culinary Pipe	1976
Emery County Total	15	

Table 9-1 (Continued)
Board of Water Resources Development Projects

Sponsor	Type	Year
	Garfield County	
Boulder Irr. & Water Dev. Co.	Dam Repair	1947
Boulder Irr. & Water Dev. Co.	Sprinkle Irrigation System	1966
Boulder Irr. & Water Dev. Co.	Sprinkle Irrigation System	1974
Boulder Irr. & Water Dev. Co.	Pressurized Pipe	1984
Boulder Irr. & Water Dev. Co.	Pressurized Pipe	1991
Cannonville Irr. Co.	Sprinkle Irrigation System	1986
Cannonville Town	Culinary Tank	1976
Christensen Ranches, Inc.	Sprinkle Irrigation System	1958
Escalante Town	Pressurized Pipe	1961
Escalante Town	Culinary Pipe	1983
Escalante Town	Culinary Tank	1991
Henrieville Irr. Co.	Sprinkle Irrigation System	1981
Henrieville Town	Culinary Pipe	1983
New Escalante Irr. Co.	Sprinkle Irrigation System	1981
Pine Creek Irr. Co.	Irrigation Well	1976
Pine Creek Irr. Co.	Sprinkle Irrigation System	1981
Ticaboo SSD	Culinary Well	1979
Tropic & East Fork Irr. Co.	Canal Lining	1962
Tropic & East Fork Irr. Co.	Dam Repair	1978
Tropic & East Fork Irr. Co.	Sprinkle Irrigation System	1987
Tropic & East Fork Irr. Co.	Pressurized Pipe	1990
Garfield County Total	21	
	Wayne County	
Caineville SSD	Culinary System	1988
East Bicknell Irr. Co.	Sprinkle Irrigation System	1963
Fremont Irrigation Co.	Dam and Reservoir	1953
Fremont Irrigation Co.	Sprinkle Irrigation System	1965
Fremont Irrigation Co.	Sprinkle Irrigation System	1968
Fremont Irrigation Co.	Sprinkle Irrigation System	1972
Fremont Irrigation Co.	Sprinkle Irrigation System	1973
Fremont Irrigation Co.	Sprinkle Irrigation System	1975
Fremont Irrigation Co.	Sprinkle Irrigation System	1975
Fremont Irrigation Co.	Dual Water System	1985
Fremont Irrigation Co.	Dam Repair	1986
Fremont Irrigation Co.	Dual Water System	1988
Fremont Irrigation Co.	Pressurized Pipe	1988
Fremont Irrigation Co.	Dual Water System	1989
Fremont Irrigation Co.	Pressurized Pipe	1993
Fremont Waterworks Co.	Culinary System	1967
Fremont Waterworks Co.	Culinary Spring	1997
Hanksville Canal Co.	Diversion Dam	1948

Table 9-1 (Continued)
Board of Water Resources Development Projects

Sponsor	Type	Year
	Wayne County (Continued)	
Hanksville Cul. Waterworks Co.	Culinary System	1978
Hanksville Cul. Waterworks Co.	Culinary Well	1992
Loa Waterworks Co., Reinc.	Culinary Pipe	1977
Lyman Water System	Culinary Pipe	1977
Lyman Water System	Culinary Spring	1983
Road Creek Water Users Assn.	Sprinkle Irrigation System	1973
Road Creek Water Users Assn.	Regulatory Pond	1986
Road Creek-Dry Valley WU	Sprinkle Irrigation System	1975
Sand Creek Irr. Co.	Dual Water System	1977
Sand Creek Irr. Co.	Diversion Dam	1993
Teasdale Irr. Co.	Pressurized Pipe	1960
Teasdale Irr. Co.	Sprinkle Irrigation System	1971
Teasdale Irr. Co.	Sprinkle Irrigation System	1977
Teasdale Irr. Co.	Dam Repair	1983
Teasdale Irr. Co.	Dual Water System	1988
Torrey Irr. Co.	Miscellaneous	1977
Torrey Town	Culinary Spring	1983
Torrey Town	Culinary Tank	1995
West Bicknell Irr. Co.	Sprinkle Irrigation System	1961
Wayne County Total	37	
	Kane County	
Church Wells S&D	Culinary System	1984
Kane County Total	1	

As of March 1999, $1.127 million had been spent for on-farm systems and $25.3 million for off-farm features. Total expenditures are shown in Table 9-2.

9.2.3 Environmental Considerations

Water is often viewed as a commodity for people's use with little thought given to other purposes and the processes of the hydrologic cycle. The upper portions of most of the rivers and streams flow through forested lands providing opportunities for camping, fishing, hunting, hiking and many other recreational activities. To some, sprinklers irrigating green crops in a desert climate provide a pastoral beauty not found in many arid areas. Proper development can provide an adequate quantity and quality of water for all uses including those crucial to maintaining healthy wildlife habitats. The West Colorado River Basin contains many historic places, artifact sites, and archeological sites. Future development should take all of these into consideration.

Providing instream flows as a beneficial use to maintain fish and wildlife populations, riparian vegetation and stream channels, is widely recognized as important. Although construction of reservoirs such as Joes Valley and Scofield cover some riparian habitat, they provide instream flows during the summer when streams would normally be too low to support a fishery. This is a side benefit to the primary purpose of storing and releasing irrigation water.

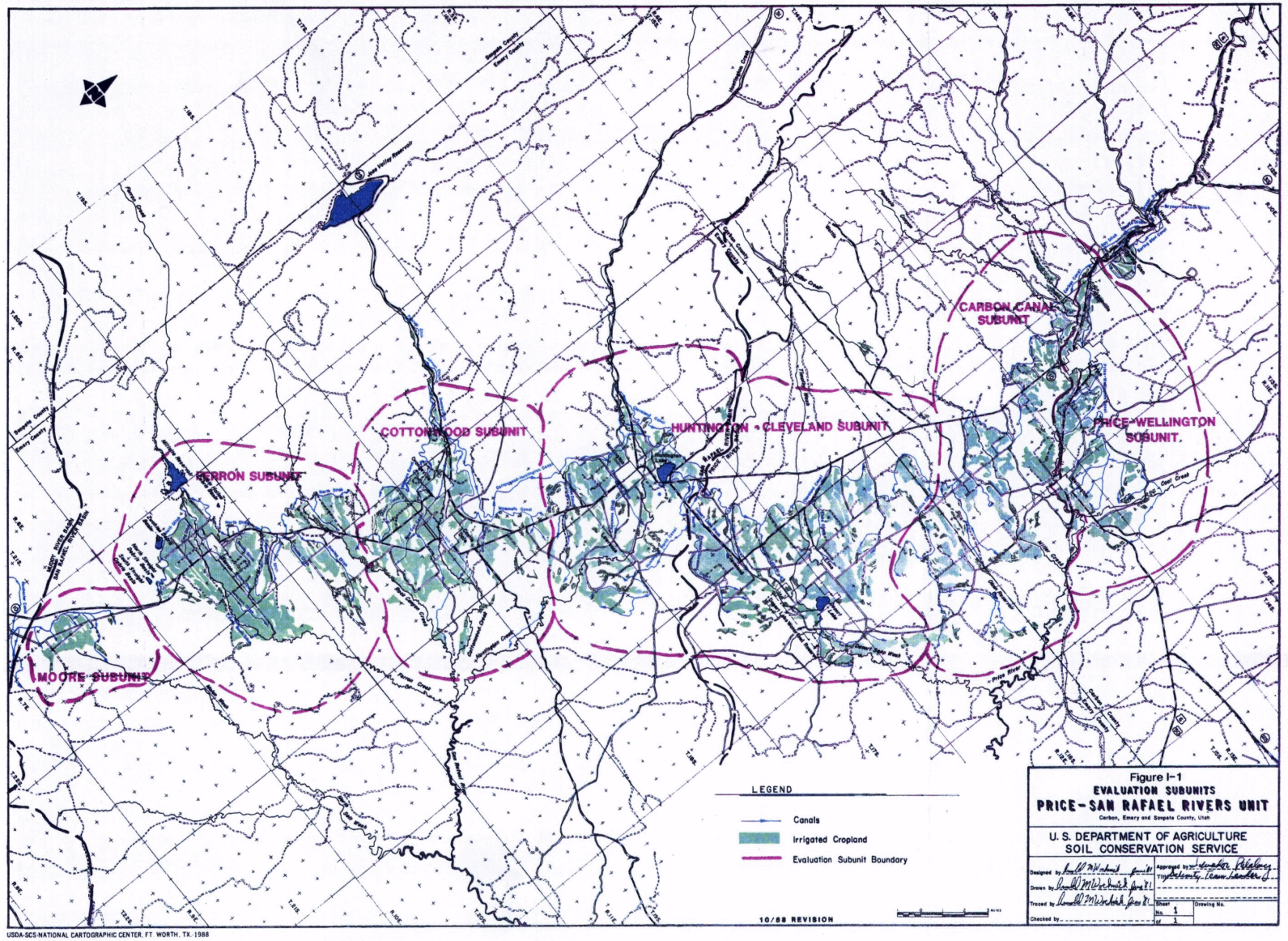

FIGURE 9-1
PRICE - SAN RAFAEL
SALINITY CONTROL PROJECT

Table 9-2 Salinity Control Project Approved Costs	
Feature	Total Cost
Off-farm pipeline systems	$30,183,300
On-farm irrigation systems	
(Federal cost share)	21,196,700
(Basin states cost share)	22,061,900
Culinary system - capital cost	1,043,000
Stockwater Ponds and Cottonwood Creek Pipeline	4,136,000
Project Total	$78,620,900

Other important factors that could affect water use and development are wilderness areas, wild and scenic designations, and the newly-created Grand Staircase-Escalante National Monument. The only designated wilderness area in the basin is the Paria Canyon Wilderness Area southwest of Big Water. However, there are 23 Wilderness Study Areas (WSAs) totaling nearly 1,731,000 acres. These WSAs are currently being managed as wilderness areas until Congress acts on their designation. An additional 1,523,000 acres of BLM lands were re-inventoried in 1999 and determined to have wilderness characteristics. The WSAs and the re-inventoried lands are listed in Table 9-3, and their locations are shown in Figure 9-2.

The Grand Staircase-Escalante National Monument has completed a three-year management analysis and a final Environmental Impact Statement (EIS) has been issued. A number of water-related issues are included in the final EIS. Also, there have been preliminary inventories made of wild and scenic rivers eligibility. All of these issues can be found in the Proposed Management Plan EIS, July 1999.

9.3 Water Resources Problems

Many agricultural lands in the San Rafael River, upper Muddy Creek and lower Fremont River area experience water shortages late in the irrigation season. This is primarily a problem for "direct-flow" users. The San Rafael and Price rivers are also over-appropriated. This compounds the problem (see Section 5.9).

Many locations are subject to flash flooding from summer thunderstorms resulting in high, instantaneous peak flows causing erosion, sediment deposition and other property damage. In many of the basin's storage reservoirs, part of the capacity is eventually used for sediment storage which reduces the effective water storage capacity.

9.4 Water Resources Demands and Needs [16, 18]

Municipal and industrial (M&I) water demands will continue to be the catalyst for the transfer of water from other uses. Estimates of population growth given in Section 4 are used to project M&I water needs. Agricultural water uses will decrease slightly as supplies are reallocated to satisfy M&I demands.

9..4.1 Culinary Municipal and Industrial Water Demands

Culinary water use will increase by an estimated 30 percent, or about 4,500 acre-feet, by the year 2020. This also reflects a 25 percent conservation factor (see Section 11). The current and projected culinary water diversions and depletions are shown in Table 9-4.

If additional groundwater, either from wells or springs, is developed for municipal and industrial uses, it will generally not need treatment. Surface water must be treated to meet drinking water standards.

Table 9-3
Wilderness Lands

Name	Acreage
Wilderness Study Areas	
Bull Mountain	13,251
Burning Hills	63,352
Carcass Canyon	47,440
Crack Canyon	26,640
Death Ridge	62,595
Desolation Canyon	85,519
Devils Canyon	9,111
Devils Garden	638
Dirty Devil	72,150
Escalante Canyons	760
Fiddler Butte	73,791
Fifty Mile Mountain	149,095
Fremont Gorge	2,845
French Spring-Happy Canyon	24,211
Horseshoe Canyon (North)	20,211
Horseshoe Canyon (South)	39,855
Link Flats ISA	855
Little Rockies	40,792
Mexican Mountain	58,929
Mount Ellen-Blue Hills	81,450
Mount Hillers	19,186
Mount Pennel	77,024
Mud Spring Canyon	38,159
Muddy Creek	31,138
North Escalante Canyons/The Gulch	119,806
Paria Canyon-Vermilion Cliffs Wilderness	22,551
Paria-Hackberry	137,011
Paria-Hackberry (202)	394
Phipps-Death Hollow	42,755
San Rafael Reef	63,006
Scorpion	36,074
Sids Mountain/Sids Cabin	78,716
Steep Creek	22,139
The Blues	19,572
The Cockscomb	9,919
Turtle Canyon	5,697
Wahweap	133,940
Subtotal	1,730,577

Table 9-3 (Continued)
Wilderness Lands

Wilderness Lands	
Name	Acreage
1999 Re-Inventoried Wilderness Lands	
Box Canyon	2,968
Bull Mountain	5,190
Bullfrog	32,983
Burning Hills	12,577
Carcass Canyon	33,934
Cave Point	5,894
Cedar Mountain	17,296
Colt Mesa	27,878
Desolation Canyon	45,192
Devils Canyon	10,615
Dirty Devil/French Springs	112,992
Dogwater Creek	3,137
East of Bryce	787
Fiddler Butte	19,962
Fifty Mile Bench	12,897
Fiftymile Mountain	31,763
Forty Mile Gulch	5,379
Fremont Gorge	16,073
Hondu Country	22,390
Horse Mountain	12,345
Horse Spring Canyon	31,758
Horseshoe Canyon	25,118
Hurricane Wash	9,027
Jones Bench	3,318
Labyrinth Canyon	43,633
Lamp Stand	3,480
Limestone Cliffs	27,615
Little Egypt	22,341
Little Rockies	31,915
Long Canyon	17,716
Mexican Mountain	46,797
Mount Ellen-Blue Hills	40,398
Mount Hillers	4,014
Mount Pennell	71,751
Mud Spring Canyon	22,176
Muddy Creek-Crack Canyon	214,892
Mussentuchit Badland	26,547
Nipple Bench	29,345
North Escalante Canyons	25,856
Notom Bench	6,961

Table 9-3 (Continued)
Wilderness Lands

Name	Acreage
Paria-Hackberry	33,359
Phipps-Death Hollow	4,678
Ragged Mt	29,266
Red Desert	34,674
San Rafael Reef	45,181
Scorpion	13,587
Sids Mountain	28,861
Squaw Canyon	14,689
Steep Creek	8,027
Studhorse Peaks	22,278
The Blues	1,608
The Cockscomb	1,442
Turtle Canyon	7,340
Upper Muddy Creek	20,345
Wahweap-Death Ridg	44,011
Warm Creek	23,719
Wildhorse Mesa	53,888
Subtotal	1,523,863
TOTAL WILDERNESS LANDS	3,254,442

9.4.2 Secondary Municipal and Industrial Water Needs

Secondary (dual) water systems provide irrigation water for landscape and turf irrigation. Parks, golf courses and other large grass areas are ideal candidates for secondary systems along with any other outside uses not requiring water of culinary standards. Many communities in the basin have secondary water systems so the potential for additional dual systems is not as great here as in other parts of the state.

Castle Valley Special Service District delivers secondary water to most of the communities in Emery County. Other communities of the basin use ditch and pressurized systems from various irrigation companies for lawn and garden watering.

The four coal-fire power plants (Price, Huntington, Hunter and Sunnyside) use untreated surface water for cooling their electrical steam generation plants. The projected diversion needed by the year 2020 is an additional 6,000 acre-feet. Current and projected secondary water diversions and depletions are shown in Table 9-5.

9.4.3 Irrigation Water Needs

Due to small amounts of farmland taken out of production, the area of irrigated cropland decreased by about 5 percent from 1968 to 1991. As the future population grows, particularly in the Garfield County area, some of the new residential and commercial developments may displace presently irrigated farmland. Overall, the irrigated land area is expected to change only slightly in the next 30 years except in the Green River area which may see an increase in agriculture because of the new Gunnison Butte Mutual Irrigation and Eastside High Ditch Project. Surface supplies are the major source of irrigation water in the entire West Colorado River Basin. Overall, about 95 percent of the irrigation water supply comes from surface water sources. Groundwater supplies a small amount of irrigation water in the Loa/Bicknell area. Table 9-6 shows the current and projected irrigation water diversions and depletions.

9.4.4 Fish and Wildlife Water Needs

Wetlands and riparian areas are important habitats for fish and wildlife. Many of the wetlands

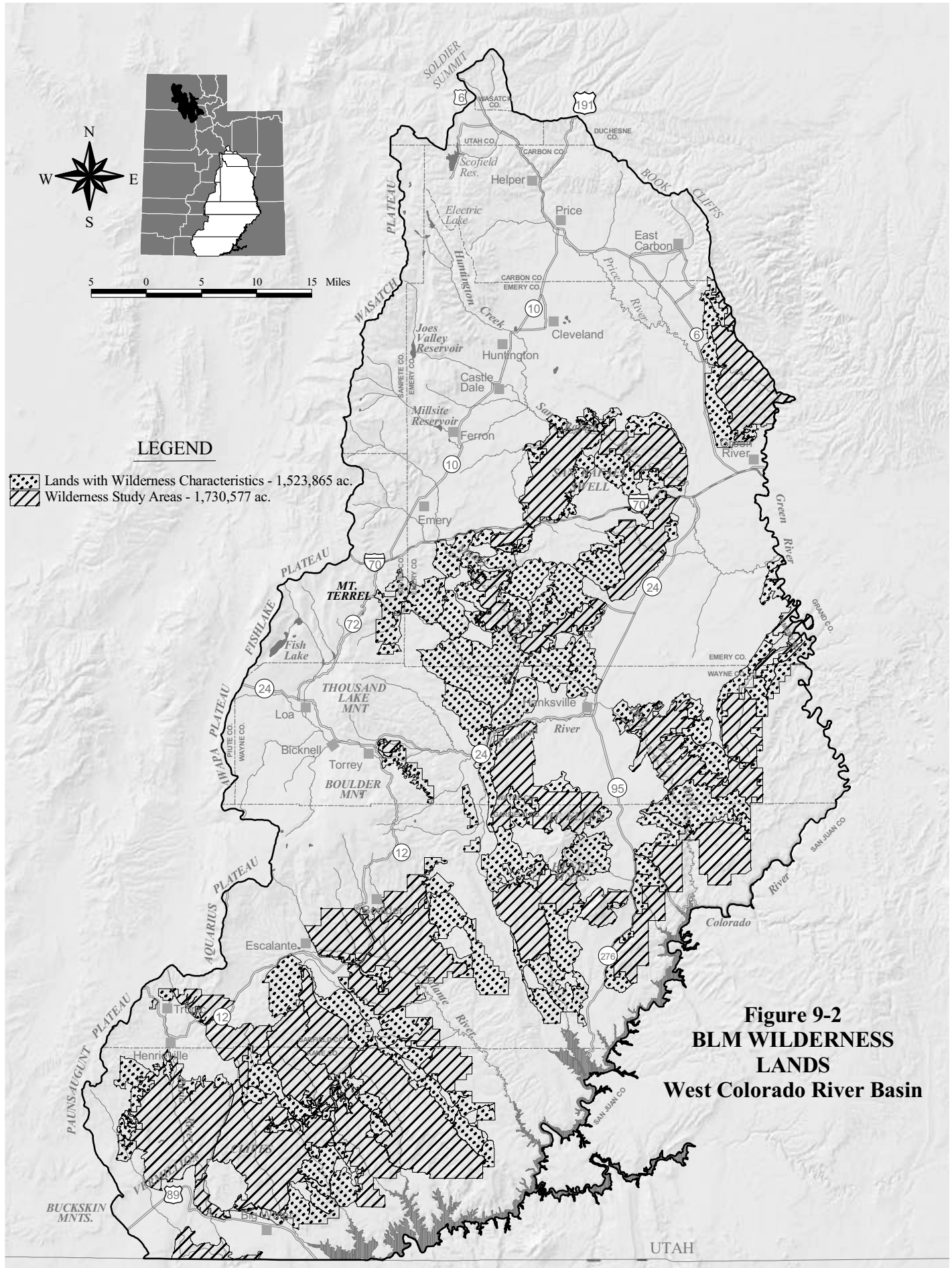

Figure 9-2
BLM WILDERNESS LANDS
West Colorado River Basin

Table 9-4
Current and Projected Culinary Water Use

Year	County								Total Diversion	Depletion
	Carbon	Emery	Wayne	Garfield	Kane	Utah	Sevier	Sanpete		
	(acre-feet)									
1996	9,048	3,582	872	633	441	1	22	2	14,601	8,400
2010	10,600	4,100	1,100	800	600	1	30	3	17,234	9,900
2020	11,700	4,300	1,400	1,000	700	1	40	5	19,146	11,000

Table 9-5
Current and Projected Secondary Water Use[1]

Year	County								Total Diversion	Depletion
	Carbon	Emery	Wayne	Garfield	Kane	Utah	Sevier	Sanpete		
	(acre-feet)									
1996	3,121	35,601	1,141	704	0	0	0	0	40,567	35,000
2010	3,500	38,000	1,500	900	0	0	0	0	43,900	38,000
2020	4,000	40,000	1,800	1,000	0	0	0	0	46,800	41,000

[1]Includes self-supplied industrial power plants and mining water use in Carbon and Emery counties. Also contains some pasture land irrigated within the cities served by the Castle Valley Special Service District's secondary water system.

Table 9-6
Current and Projected Agricultural Water Use

Drainage	1990 Diversions	1990 Depletions	2020 Diversions	2020 Depletions
		(acre-feet)		
Price	84,450	43,000	80,000	45,000
San Rafael	81,700	52,700	78,000	55,000
Dirty Devil	83,400	43,600	80,000	42,000
Escalante	23,100	12,400	22,000	12,000
Paria	7,750	3,500	7,000	3,000
Lower Green	14,650	6,500	40,000	22,000
Total	295,050	161,700	307,000	179,000

in Carbon and Emery counties east of the Wasatch Plateau were artificially created by irrigation return flows. Cottonwood Irrigation Company dedicated 145 acres of wetlands through one of its irrigation projects. Utah Power donated a 38.99 cfs instream flow right for 65 miles on the Lower San Rafael River. Projects such as these should continue to ensure multiple use of the basin's water resources. Some areas should be preserved to accommodate amphibians and non-game species. Habitat in some areas can be improved from poor or fair condition to good condition. Waterfowl areas can be improved by interseeding, stabilizing the water supply and provided nesting facilities. Fisheries can be rehabilitated by using stream bank and channel measures to stabilize streambeds and provide pools. Priorities could be given to areas where there is greater potential for improvement, when a review of existing water uses would allow it.

9.4.5 Recreational Demands

The West Colorado River Basin contains eight state parks, one national park (small parts of two others), one national recreation area, one national monument, three national forests, and numerous other recreational areas of various kinds. The recreational activities range from camping, hiking, nature study, hunting, river-running, golfing and water sports in the summer to cross-country skiing, snowmobiling, hunting, ice fishing and sledding in the winter.

Sightseeing is popular at any time of the year. Opportunities for recreation range from the colorful desert areas such as Capitol Reef National Park and the Grand Staircase-Escalante National Monument to the majestic mountain areas such as those found in the Manti-La Sal, Fish Lake and Dixie National forests. Water-based recreation is provided by the many lakes, reservoirs and streams in the basin. Joes Valley, Scofield and Wide Hollow reservoirs and Fish Lake provide water skiing and boating as well as fishing. Lake Powell is a world-class houseboating and waterskiing destination. Fishing is popular on many rivers and streams, including the White River, Seely Creek, Huntington Creek and the Fremont River. World class river-rafting is found on the Colorado and Green rivers through Cataract, Gray, Labyrinth and Stillwater canyons.

9.4.6 Water Use Summary

All current water use and projected demands are based on currently available data. These are shown in Table 9-7 for 1995, 2020 and 2050.

9.5 Water Development and Management Alternatives

The existing water supplies can be enhanced through reservoir storage, transbasin diversions,

Table 9-7
Summary of Current and Projected Water Demands

Use	1998[1] Diversions	1998[1] Depletions	2020 Diversions	2020 Depletions	2050 Diversions	2050 Depletions
	(acre-feet)					
Municipal and Industrial						
Culinary	14,600	8,400	19,200	11,000	25,000	14,000
Untreated:						
Residential Secondary	8,370	4,200	14,600	10,200	17,800	13,200
Industrial	32,200	30,800	36,500	35,000	36,500	35,000
Irrigation	295,050	161,700	281,000	179,000	262,000	167,000
Basin Total	350,220	205,100	351,300	235,200	341,300	229,200

[1]M&I based on 1996 study. Irrigation based on 1990 water budget.

weather modification, water transfers, and water education and conservation.

9.5.1 Water Supply Management

By bringing in industry, improving watersheds, converting to sprinkler irrigation, and developing secondary dual water systems, the West Colorado River water users have accomplished much in the way of water supply management. But there are always additional opportunities to improve the efficient use and management of the water resources. This applies to all uses. Users can better manage their water supplies by increasing efficiencies which in turn can reduce costs, and by using prudent application of water for landscaping and other outside residential purposes. There is a need to properly manage the groundwater reservoirs in the West Colorado River Basin. Water managers should always be searching for ways to conserve the available supply so development of other costly sources can be eliminated or postponed. Education and training can be an effective tool.

One of the tools used in planning and design of water projects is computer modeling. This can be used to simulate river systems to determine reservoir yields, hydroelectric power production, water shortages and the effect on the river systems as new developments become operational. Reservoir operation procedures can be fine-tuned with models to maximize the available water for use and minimize any problems associated with changing flow regimes. Computer models are also a useful tool for simulating operation of groundwater reservoirs.

"Real time" water-management systems can help irrigation companies become more efficient. The Emery Water Conservancy District has had such a system for the Cottonwood and Huntington irrigation districts for the last six years. This sophisticated computer-controlled system has greatly increased the efficiency of the large distribution canals located in Emery County.

9.5.2 Surface Water Storage Facilities [15]

Over the years, many potential reservoir sites have been investigated to varying degrees of detail. Investigations have been made by the Utah State Engineer, Division of Water Resources, Corps of

Engineers, Natural Resources Conservation Service (NRCS), and the Bureau of Reclamation. Local entities, with help from engineering firms, also have conducted investigations on reservoir sites. Locations of these sites are shown on Figure 9-3. Sites, along with the sponsors, are included in Table 9-8. Many of these sites are on the same stream segment. In these segments, only one of these sites would ever be developed. Future water storage reservoirs will only be feasible if constructed as multipurpose projects. Planning for these projects most include biological and environmental studies.

Currently the New Escalante Irrigation Company, through the Wide Hollow WCD, is investigating replacing Wide Hollow Reservoir (see Table 9-8) with a new reservoir. The BLM is currently working on an Environmental Assessment (EA) for this project. A new off-stream reservoir would be built with a capacity of between 4,000-6,000 acre-feet. The existing Wide Hollow Reservoir does not meet dam safety standards, and the capacity would be reduced to 400 acre-feet. Water would be directed from North Creek and Birch Creek in a pipeline and delivered to the new reservoir.

9.5.3 Water Conveyance and Delivery Systems

Much has been done to improve the conveyance and delivery systems for all uses. Pipelines and canal lining have been installed in many areas of the basin to reduce the loss of irrigation water. Water management with sprinkler systems is very effective in increasing on-farm efficiencies. Gated pipe is also effective where pressurized systems are not available or too costly.

Improvements have been made in systems delivering municipal and industrial water. However, there will be locations where systems will need to be upgraded. By keeping distributions systems in good condition, current water supplies can be stretched to meet most of the future needs.

9.5.4 Weather Modification

Weather modification or cloud seeding, has long been recognized as a means to enhance existing water supplies. Cloud seeding had its beginnings in 1946 at the General Electric Research Laboratories in Schenectady, New York. Cloud seeding can assist nature in the formation of precipitation, with appropriate types and numbers of nuclei at the proper times and places. Cloud seeding projects have been carried out in over 20 countries. Projects are generally conducted either during the winter or summer months. While wintertime projects target the enhancement of mountain snow-pack within a watershed, summertime projects are aimed at enhancing precipitation and/or reducing damage from hail.

"Seeding" winter storm clouds over mountains is well established and understood. Clouds form as moist air is lifted and cooled during its passage across mountain ranges. Left to nature, many clouds are highly inefficient precipitators, retaining more than 90 percent of their moisture. By cloud seeding, the precipitation efficiency can be greatly improved. Generally, silver iodide is used in ground generators to produce artificial ice nuclei that form ice crystals. Spreading the nuclei via aircraft is also common. These crystals attract moisture from the surrounding air forming droplets that grow large enough to fall to the ground as snow. Some projects using ground-based silver iodide generators to seed winter storms over mountain areas in the western United States have operated continuously since 1950.

Precipitation data from a number of cloud seeding projects have been examined in detail for evidence of downwind effects. Results from these analyses show a slight increase in precipitation in areas up to 90 miles downwind from the project area. No decrease in precipitation has been detectable farther downwind from any long-term cloud seeding project.

The first cloud seeding project in Utah began in the early 1950s in the central portion of the state. Cloud seeding started again in 1973 and has continued to the present. In 1973 the Utah Legislature passed the Utah Cloud Seeding Act. This law provided for licensing cloud seeding operators and permitting cloud seeding projects by the Utah Division of Water Resources. The act states that for water right purposes all water derived from cloud seeding will be treated as though it fell naturally. The act also allowed for the division to sponsor and/or cost share in cloud seeding projects.

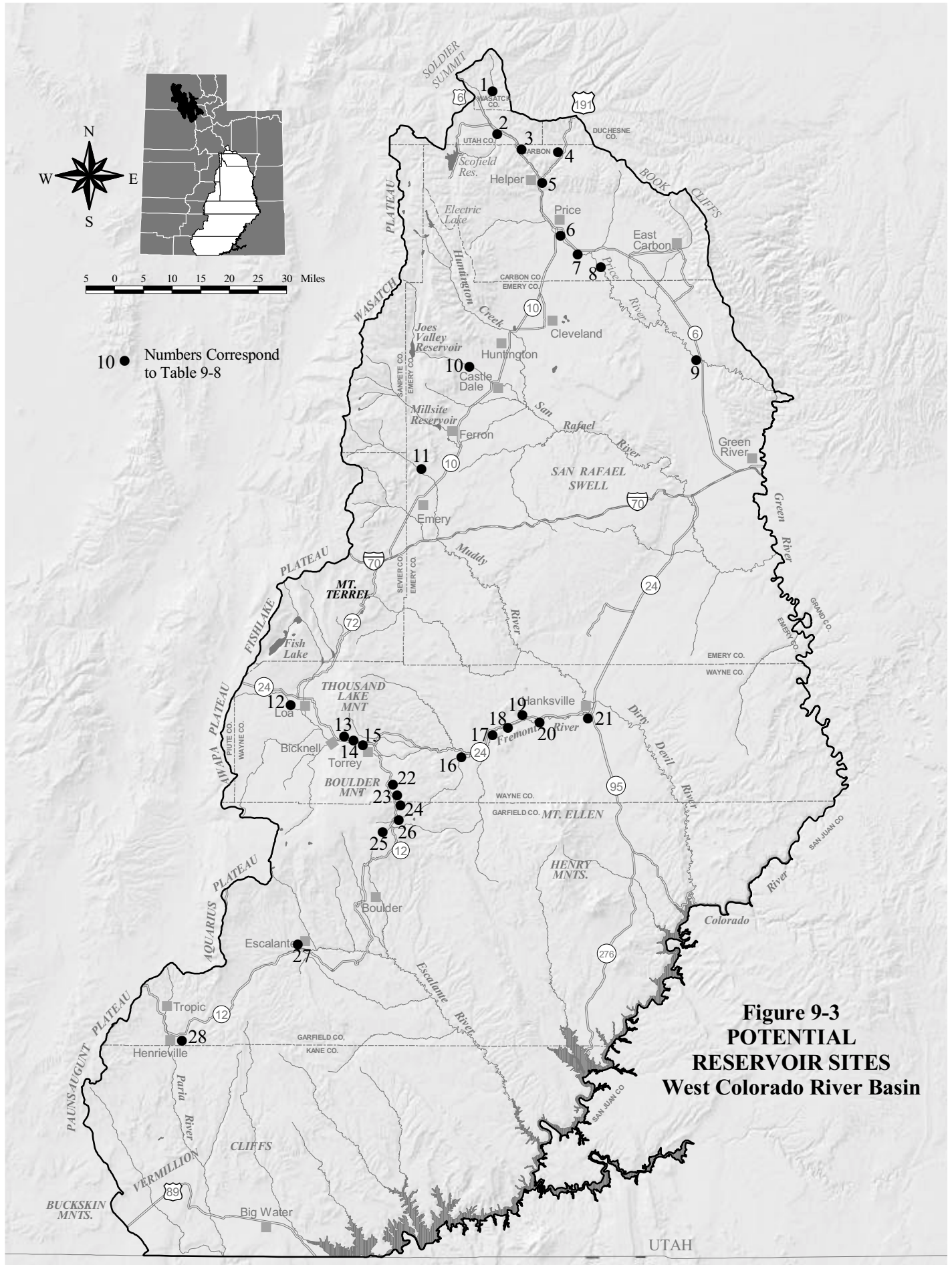

Figure 9-3
POTENTIAL RESERVOIR SITES
West Colorado River Basin

Table 9-8
Historical Reservoir Site Investigations

Figure 9-2 No.	Name	Stream	Sponsor	Type
	Price River			
1	White River	White River	Price River Water Users	R
2	Coulton	Price River	US Bureau of Reclamation(USBR)	R
3	Richards	Price River	USBR	R
4	Willow Creek	Willow Creek	USBR	R
5	Helper	Price River	USBR	R
6	Farnham	Price River	USBR	R
7	Edwards	Price River	USBR	R
8	Wellington	Price River	USBR	R
9	Woodside	Price River	USBR	R
	San Rafael River			
10	Adobe Wash	Cottonwood Creek (Off-stream)	Cottonwood Irrigation Company	R
	Dirty Devil River			
11	Muddy Creek	Muddy Creek	Four Corners Regional Commission	G,D
12	Road Creek	Road Creek		
13	Torrey (Poverty Flat)	Fremont River	Wayne County Water Conservancy District(WCWDCD)	R,G, S,D
14	Garkane	Fremont River	WCWCD	R,S
15	Hickman	Fremont River	WCWCD	R
16	Aldrich	Fremont River	WCWCD	R
17	Caineville #2	Fremont River	WCWCD	G,S
18	Caineville Reef	Fremont River	WCWCD	R
19	Caineville Wash	Fremont River (Off-stream)	WCWCD	R
20	Blue Valley	Fremont River	WCWCD	G,S
21	Hanksville Offstream Ponds	Fremont River	WCWCD	R
22	Rock Springs Draw	Rock Creek	Division of Water Rights(DWRi)	R
23	Snow	Rock Creek	DWRi	R
24	Beef Meadows	Rock Creek	DWRi	R
25	Pleasant Meadows	Pleasant Creek	DWRi	R
26	Pleasant Creek	Pleasant Creek	DWRi	R
	Escalante River			
27	Wide Hollow Replacement Dams	Escalante River (Off-stream)	Wide Hollow Water Conservancy District	R
	Paria River			
28	Henrieville	Henrieville Creek	Tropic Irrigation Company	R
29	Bryce Valley Sites	Offstream	Tropic, Henrieville and Cannonville	R

Investigation Type
R = Reconnaissance Report S = Seismic (Geophysics)
G = Geology Investigation/Drilling D = Design Report

Since 1976, the state, through the Division and Board of Water Resources has cost shared with local entities for cloud seeding projects. Recent cost sharing by the board has varied between 25-50 percent, depending on the size of the program.

There are two winter time cloud seeding projects in the West Colorado River Basin. The large central and southern Utah project, using silver iodide, targets the headwaters of most watersheds in the West Colorado River Basin. A small project using liquid propane is operated on the Wasatch Plateau above Joes Valley Reservoir.

Statistical analyses of the Central and Southern Utah Project with over 20 years of operation and data indicate a December through March precipitation increase of about 15 percent and an April 1 snow water content increase of about 10 percent. Runoff analysis in Utah indicates a 10 percent increase in April 1 snow water content will result in a 10 to 20 percent increase in the April-July runoff depending on individual watersheds.

9.5.5 Water Education

Water education provides an excellent approach to help children learn how to be responsible citizens. As they learn about water, they gain a respect for this resource which will become more and more important as water-related issues become prominent. The purpose of the Division of Water Resources (DWRe) Water Education Program is to educate students in grades K-12 about water from where it comes to where it goes. Children in turn learn to make decisions based on a knowledge of water and its origins.

Water education is achieved through various means. The state of Utah participates in the international water education program called Project WET (Water Education for Teachers). Project WET workshops are held throughout the state in order to train educators to use the collection of 90 innovative, interdisciplinary activities. Teachers are required to teach various aspects of water, and Project WET is a good tool for them to use. The program fits into a wide range of curriculum from science to social studies.

The water education program is ever expanding. The goal is to give educators the best resources possible. Part of the program includes outreach to schools. School programs are presented on topics relating to water, which are required to be taught in the state curriculum. Also, brochures and resource lists are provided to educators relating to water. The DWRe has been active in sponsoring water fairs for schools. These water fairs will continue to be an important avenue to teach children about all aspects of water.

The annual Young Artists' Water Education Poster Contest is an event which continues to be the highlight of October, which is Water Education Month. Children in grades K-6 participate in this statewide contest each year. Themes chosen each year all relate to water as a resource. The West Colorado River Basin is highly active in the contest. In 1998, all divisions were won by children from Emery County.

9.6 Projected Water Depletions

Projected in-basin water depletions are shown in Table 9-7. Two potential projects will also export water out of this basin for uses in other parts of the state. Other potential projects could develop up to 50,000 acre-feet on the lower Fremont River in Wayne County and 25,000 acre-feet near Green River in Emery and Grand counties.

9.6.1 Gunnison Butte Mutual Irrigation Project

The Gunnison Butte Mutual Irrigation Company was recently incorporated in the Green River area. They are preparing to divert water directly out of the Green River to irrigate about 5,000 acres of new lands that they currently own or have leased, and about 1,500 acres of supplemental lands. This will supply established markets with melons, corn, alfalfa, sod and various row crops. Additionally, there are school trust lands that could be included in the project if water were available. The irrigation company recently received a water right from the Utah Board of Water Resources' Flaming Gorge Water Right for 24,825 acre-feet of diversion and 15,143 acre-feet of depletion.

The project area has over 100 years of successful agricultural production. There are established farmers and water delivery systems, including a major diversion dam on the Green River,

which will reduce the farming costs and add to the project's financial feasibility. There are established markets and transportation systems. Green River melons and alfalfa are known for their quality and excellence.

City of Green River officials have contributed significantly to the successful formation of the Gunnison Butte Mutual Irrigation Company, which was organized exclusively to receive and develop Flaming Gorge water. The company members are enthusiastic and some have expended considerable effort to evaluate their proposed farming applications. Figure 9-4 shows the location of the proposed project's agricultural lands.

9.6.2 Wayne County Water Conservancy District Project

The Wayne County Water Conservancy District has a 50,000 acre-foot water right on the Fremont River which was approved in 1963. Numerous potential reservoir sites have been proposed by the district as multi-use projects including irrigation, municipal and industrial, and recreational water benefits to the lower Fremont River system. To date, none has been found to be economically feasible.

A new proposal is looking at possibly changing this water right from a surface right to a groundwater right. This project would then pump water (possible from the Navajo Sandstone aquifer) to irrigate approximately 6,000 acres of new arable lands in the Cainville and Hanksville area as well as providing municipal and industrial water for local communities.

9.6.3 Narrows Project [52]

The Sanpete Water Conservancy District is sponsoring the completion of the Gooseberry Project (see Section 3.4). This project would export about 5,400 acre-feet of water out of the Price River drainage and into the Sevier River Basin. The project is controversial and is in the final permitting stage. For more information, see the *Sevier River Basin Plan, June 1999.*

9.6.4 Lake Powell Pipeline

The Washington County Water Conservancy District (WCWCD) commissioned the Lake Powell Pipeline Study to further investigate the feasibility of delivering a portion of Utah's Upper Colorado River water from Lake Powell to Washington County to accommodate the projected growth in the area. The pipeline would deliver about 70,000 acre-feet of water to Washington County and 6,000 to Kane County. A pump station would be located at Lake Powell southeast of Big Water. The pipeline would follow U.S. Highway 89 west through the Grand Staircase-Escalante National Monument toward Kanab and St. George. This would be an export from the West Colorado River Basin and an import to the Virgin River/Kanab Creek Basin. The projected time frame for constructing the project is 2025-2035.

9.7 Policy Issues and Recommendations

Four policy issues are discussed. These are: 1) Preservation of potential reservoir sites, 2) water development in proposed new federal designations, 3) long-range planning, and 4) draining Lake Powell.

9.7.1 Preservation of Potential Reservoir Sites

Issue - Potentially feasible reservoir sites should be identified and protected.

Discussion - Construction of additional water storage facilities may be needed in order to provide for projected needs and demands. Other developments often infringe on these sites, prohibiting their use for water storage facilities or requiring expensive relocation costs. Also, the possible development of some sites is prevented when the areas are withdrawn for other purposes such as proposed wilderness areas or for wild and scenic river designation. Preservation of potential reservoir sites would eliminate this problem.

Over the years, many potential reservoir sites have been investigated in the West Colorado River Basin. Investigation detail varies from cursory on-site evaluations to geotechnical work. Many of the sites have been or will be disqualified in the future as more detailed investigations or other factors eliminate them from consideration. In the final analysis, only a few of the sites will actually be utilized to provide water storage.

Recommendation - Water conservancy districts and other appropriate entities should act to identify

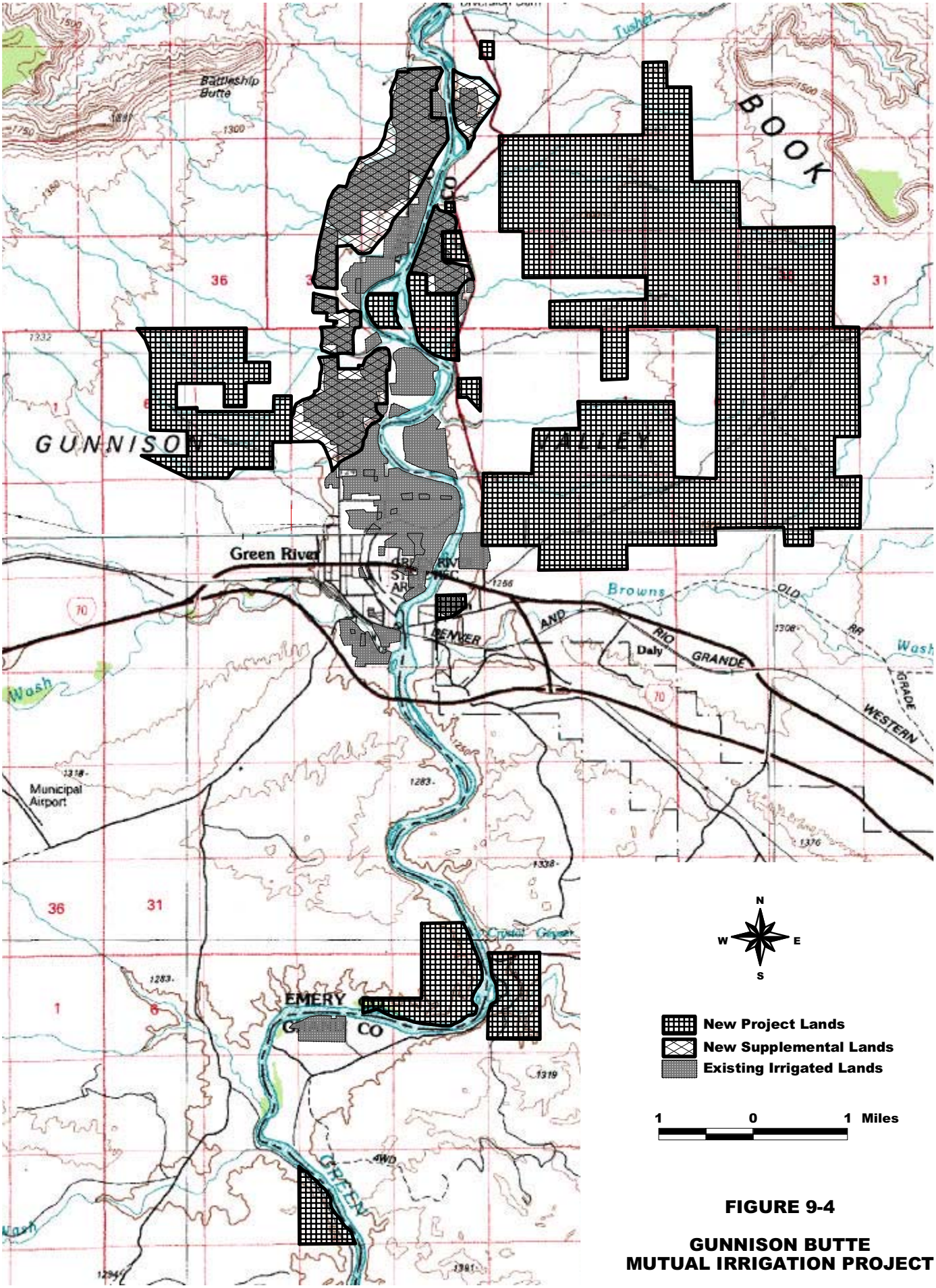

FIGURE 9-4

GUNNISON BUTTE MUTUAL IRRIGATION PROJECT

and petition the appropriate state or federal agency to protect potential water storage sites. The Forest Service and Bureau of Land Management should identify and evaluate potential reservoir storage sites in their planning processes.

9.7.2 Federal Land Designations

Issue - Designation of proposed new wilderness areas and the new Grand Staircase-Escalante National Monument may restrict or prohibit future water resource development and maintenance of existing water supply facilities.

Discussion - The basin contains 37 wilderness study areas as well as new re-inventoried lands with wilderness characteristics, totaling about 3,255,000 acres (See Table 9-3 and Figure 9-2). Several of the proposed wilderness lands contain potential sites for wells and sources of surface water which could be used to meet future municipal, industrial, livestock and wildlife water needs. Recent studies show that potential reservoir sites in Bryce Valley (sometimes referred to as Tropic Valley) exist in some of the proposed wilderness lands as well as in the new Grand Staircase-Escalante National Monument (GSENM). Existing water developments projects can still be used, but future access for operation and maintenance will be more difficult. Due to its proximity to the new GSENM, Bryce Valley (sometimes referred to as Tropic Valley) is expecting to grow at a greater rate than the rest of the basin. Figure 9-5 shows the complexity of this area, surrounded by Bryce Canyon National Park and the new GSENM. Similar situations exist around Escalante and Boulder.

Recommendation - Water users, county commissioners, mayors, and state officials should continue to keep Congress and appropriate federal agencies aware of the need to allow watershed improvement and surface water and groundwater resources development within future federal land designations.

9.7.3 Long-Range Planning

Issue - Coordinated long-range planning is needed at all levels in the use and management of the water and water-related land resources.

Discussion - The natural resources of the West Colorado River Basin, particularly those related to water, are vitally important to every individual, organization and government entity involved in their conservation, development and use. The ultimate use and disposition of resources should be coordinated among all appropriate entities, including individuals. Land owners, resource users, and administrators of federal, state, and local agencies should strive for acceptable compromises and have a willingness to work toward a common goal.

Long-range plans are a tool to help develop and conserve the existing resources to meet future demands. Water and land provide the basics to support life. Other important considerations include preserving areas for recreation and leisure activities and providing wildlife and habitat for the enjoyment of future generations.

Resource planning can also help where federal laws and mandates dictate use of lands. Local long-range resource plans can require federal agencies to take local desires and needs into consideration.

Past planning has dealt more with resource quantities. Future planning should also emphasize the quality aspects of resources. To assist with this, the present state policy is to provide technical assistance to help counties conduct resource inventories and prepare plans. The resources of the Governor's Office of Planning and Budget have been made available when needed. Additional planning assistance is also available from several state and federal agencies. Recently, Carbon, Emery and Wayne counties used the Governor’s Office of Planning and Budget to write their plans.

Recommendation - Local governments and water user groups should prepare long-range plans concerning the basin's natural resources. Counties should take the lead through their land-use planning process with assistance from state and federal agencies.

9.7.4 Draining Lake Powell

Issue - The Sierra Club and the Grand Canyon Institute have proposed to restore Glen Canyon by draining Lake Powell.

Discussion - Impacts of Draining Lake Powell from information presented at the April 1998 Congressional Hearing by the basin states, federal

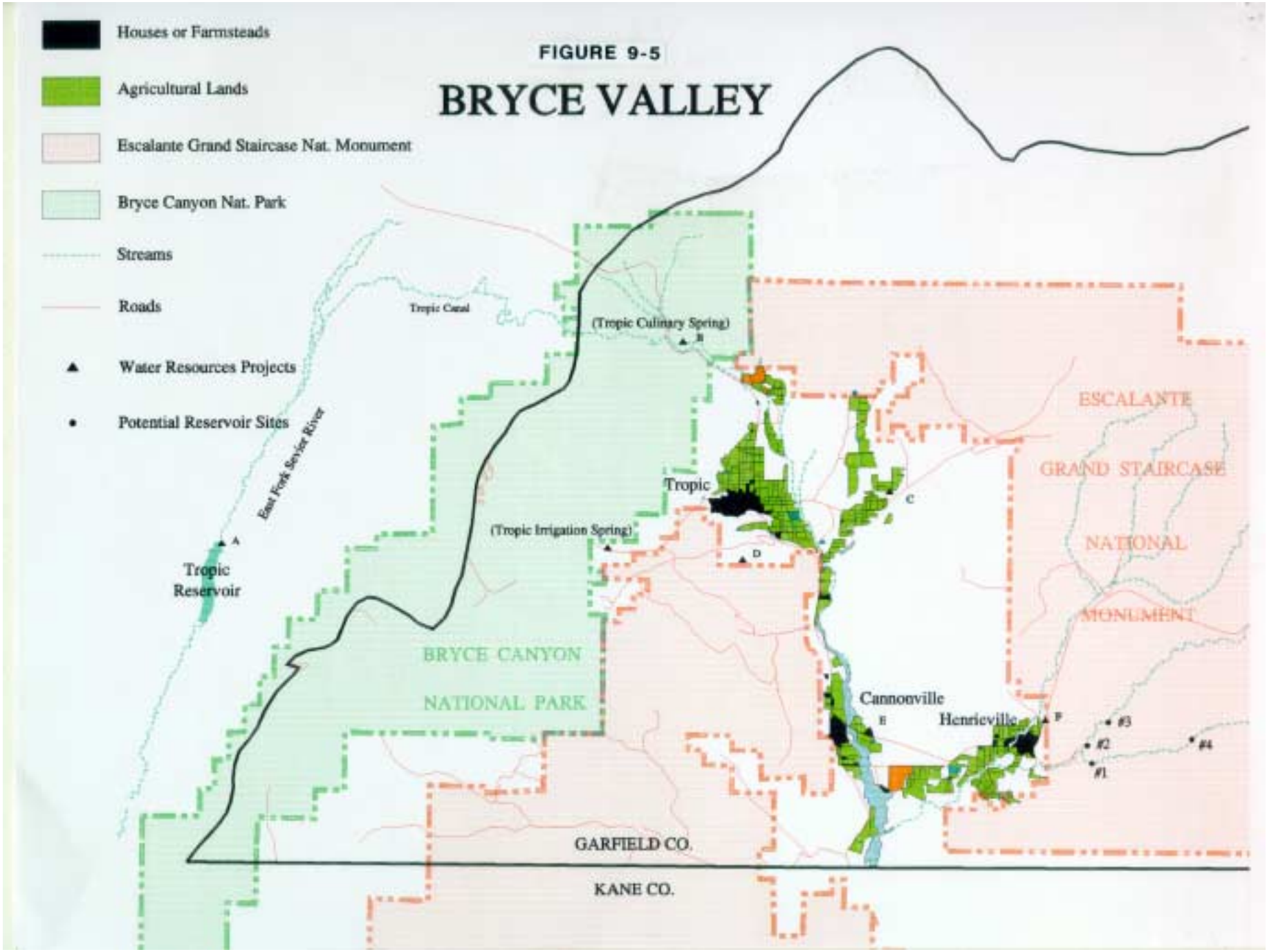
FIGURE 9-5
BRYCE VALLEY
Houses or Farmsteads
Agricultural Lands
Escalante Grand Staircase Nat. Monument
Bryce Canyon Nat. Park
Streams
Roads
Water Resources Projects
Potential Reservoir Sites
Tropic Canal
(Tropic Culinary Spring)
East Fork Sevier River
Tropic
(Tropic Irrigation Spring)
Tropic Reservoir
ESCALANTE
GRAND STAIRCASE
NATIONAL
MONUMENT
BRYCE CANYON
NATIONAL PARK
Cannonville
Henrieville
#1
#2
#3
#4
GARFIELD CO.
KANE CO.

agencies, tribes, power users, recreationists and water users, the following impacts of draining Lake Powell have been identified.

Recreation Opportunities Lost

- Almost three-million people annually visit Glen Canyon National Recreation Area. Lake Powell draws the vast majority of these visitors. Without it, visitation would be minimal.
- About one-half million boating days are logged annually at Lake Powell. Draining the lake would provide more "wild river" for river runners, but the number of new opportunities would pale compared to the boating days that would be lost. Also, the entire river rafting industry in the Grand Canyon has been made possible by the regulation provided by Glen Canyon Dam. This too would be severely impacted.
- About 30,000 angler-days are spent annually on the blue-ribbon trout fishery below the Glen Canyon Dam. That fishery, those days and the warm-water angler-days on the lake itself would be lost.
- The trade-off for draining Lake Powell would be a loss of recreational opportunities for millions of people in exchange for a different type of recreation (river running through Glen Canyon) for a few thousand.

Economic Impacts

- Visitation to the Glen Canyon National Recreation Area, including boat rental at the lake and the fishing activity below the dam, is estimated to generate in excess of $400 million per year to local and regional economies. The vast majority of this would be lost.
- Some 2,000 private boats are berthed at Lake Powell. By federal law, the vast majority of these boats are registered in the state of Utah, and annual property taxes are paid as part of the registration process. Utah counties could lose hundreds of thousands of dollars annually in tax revenue.
- The Navajo Tribe would experience a significant financial loss. The Navajo Generation Station, one of few such amenities that has been provided to an Indian Tribe, could be shut down with a loss of over 1,900 jobs and associated power. If the Navajo Power Project were to remain operational, significant and costly modification would be required increasing energy costs to more than three million customers. In addition, tourism industry revenues would be lost to the tribe.
- If the proposal is pursued, a costly EIS would likely be required. Extent of the cost is uncertain, but the recently completed Glen Canyon EIS cost $80 million and took about 10 years to complete.
- Structural modifications to Glen Canyon Dam to allow Lake Powell to be drained would be expensive.
- Glen Canyon Dam provides flood control benefits to the Lower Basin states and Mexico. It is impossible to quantify future costs that might be incurred without its ability to control flood flows, but it is expected that such costs could be substantial.
- Loss of 3,500 gigawatt hours of hydroelectric power, producing revenues of $80 million yearly.

Environmental

- Post-dam riparian conditions in the Grand Canyon appear no worse than before the dam was constructed, but they are substantially different. Operation of the dam has created a refuge for birds of regional significance, a cold-water blue-ribbon trout fishery, and a regulated river with high biodiversity. If the lake is drained, all this will be lost.
- A complete restoration of Glen Canyon is questionable. Draining the lake would leave formations around the reservoir bleached (bathtub ring), expose significant debris, and create potential problems with sediment that has been deposited in the reservoir. This may dry along rock walls

and become airborne during windstorms creating dust and air quality problems.
- If it becomes necessary to replace the lost energy generation, it could become environmentally significant and will be expensive.

Water Supply
- Upper Basin States would be further constrained in developing their remaining compact allocations. During a prolonged drought, some existing Upper Basin uses might be curtailed.
- Lake Mead would fill with sediment at a much faster rate, decreasing its life expectancy.
- The construction of the Lake Powell pipeline for the delivery of water to southwest Utah would not be feasible.

Legal Issues
- Federal legislation would be required to drain Lake Powell.
- The delicate balance of water rights and water supply between the Upper and Lower Basin States could be destroyed, resulting in costly long-term negotiations or litigation and significant modification to the "Law of the River."

Arguments to Drain Lake Powell - The following points have been made by environmental groups on why Lake Powell should be drained:

- We have a stewardship to protect all of God's creations. We had no right to destroy Glen Canyon, nor the plants, animals and fish that existed in the canyon prior to the dam.
- The government misled the people in 1956; and if NEPA had existed, Glen Canyon Dam would never have been built. No one ever thought of the impacts to the environment.
- Glen Canyon Dam drowned out one of nature's finest creations and destroyed an ecosystem which can still be uncovered and restored. The decision made in 1956 can be reversed, and we can still restore Glen Canyon so we can see it again in the future.
- U.S. consumption of Colorado River water has destroyed the ecosystem of the Sea of Cortez and Colorado River Delta.
- The Grand Canyon is suffering from the construction of the dam, which has changed the temperature of the water, cut off the supply of sediment to rebuild beaches and prevents cleansing seasonal floods. Draining Lake Powell will save the Grand Canyon.
- Will help recover Colorado River endangered fish by re-establishing habitat lost under the reservoir.
- Lake Powell will fill with sediment someday; hydropower generation and water storage will be lost.
- Loss of 1.0 maf of water to evaporation and bank storage each year at Lake Powell.

Recommendation - The state of Utah feels this proposal is without merit. Lake Powell is an integral part of the water management system of the western United States, and the state should continue and expect its efforts to educate the public about the benefits and costs of water resource management. ●